

# PATENT ABSTRACTS OF JAPAN

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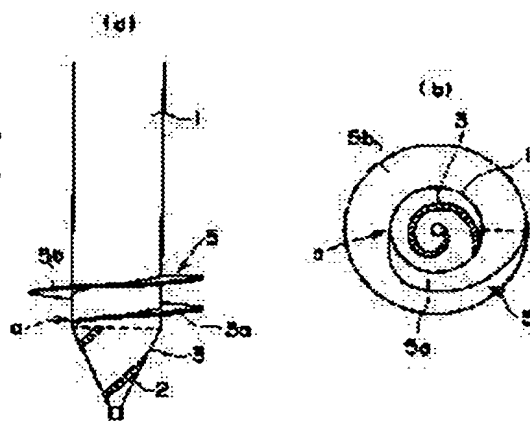
## (54) PILE WITH WING

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a pile having a wing which is hardly damaged and has an excellent penetration performance to a hard bearing layer.

**SOLUTION:** A cone-shaped conical section 2 is provided at the tip portion of a pile main body 1 made of a steel pipe. The conical section 2 additionally has a drilling blade 3 with a steel bar wound spirally or a drilling bit-shaped drilling blade thereby permitting easy excavation and penetration even to a hard layer. A spiral wing 5 is attached to the tip portion of the pile main body 1 located at the upper portion of the conical section 2.

The wing 5 has a gradually increasing portion 5a where the width of the wing begins to increase from a start end portion 'a' at the lowest end and also has a portion 5b where the width of wing continuing from the gradually increasing portion is almost constant, and the rotary penetration of the pile becomes smooth because the resistance by the ground is small at the start end portion 'a' and the gradually increasing portion 5a.



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**CLAIMS**

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[Claim(s)]

[Claim 1] The pile with an aerofoil characterized by having the part which comes to prepare an aerofoil in the upper pile periphery of said cone-like section spirally, and the span of said aerofoil increases gradually from the start edge, and preparing about one or more parts with an almost fixed span continuously while preparing the cone-like section which has a digging cutting edge in the point of a pile.

[Claim 2] The pile with an aerofoil according to claim 1 which has the part which a span dwindles further following a part with the almost fixed span of said aerofoil.

[Claim 3] The pile with an aerofoil according to claim 1 or 2 with which the reinforcing rib is prepared in the front face of said aerofoil.

[Claim 4] The pile with an aerofoil according to claim 3 with which said reinforcing rib is prepared in the outermost periphery of said aerofoil.

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## **DETAILED DESCRIPTION**

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### **[Detailed Description of the Invention]**

**[0001]**

**[Field of the Invention]** The invention in this application relates to the pile with an aerofoil which rotation penetrating is carried out all over the foundation, and constitutes a foundation pile.

**[0002]**

**[Description of the Prior Art]** Conventionally, what carries out rotation intrusion and uses an established pile with an aerofoil as a foundation pile all over the foundation is developed variously. The main purposes which prepare an aerofoil are making easy rotation penetrating to the inside of the foundation by a spiral aerofoil etc., aiming at the increment in pile bearing capacity with the wing area which serves as a major diameter compared with a pile diameter, etc.

**[0003]** As a pile which prepared such an aerofoil, while preparing a bottom plate with a digging cutting edge in the lower limit of a steel pipe pile, what prepared about one spiral aerofoil which has the outer diameter of 2 double strength of the outer diameter of the body of a pile in a lower limit section peripheral face is indicated by JP,2-62648,B. Moreover, it is supposed by that by which manufacture attached the hemicycle plate at the tip alternately as an easy aerofoil compared with the spiral aerofoil being indicated by JP,9-324425,A, JP,11-198081,A, and JP,10-159086,A, and an aerofoil being attached in a point that excessive bending stress will not occur in a steel pipe.

**[0004]** In addition, while opening the tip of a steel pipe pile, what prepared the spiral aerofoil in the tip periphery section is indicated by JP,11-269875,A.

**[0005]**

**[Problem(s) to be Solved by the Invention]** Since the tip is blockaded by the bottom plate on monotonous in the case of the steel pipe pile with an aerofoil given in JP,2-62648,B, comparatively hard supporters have the problem of being hard to carry out penetrating of the pile point. Moreover, if supporters cannot be intruded in a pile point, there is a problem that vertical bearing capacity is not acquired enough or drawing drag force becomes small.

**[0006]** Furthermore, since the span is fixed from the aerofoil start edge, in case the foundation is made to carry out penetrating and it goes to it, rotating, it is easy to damage an aerofoil edge and there is a possibility of causing trouble to pile penetrating. Although the format which attached the alternate hemicycle plate at the tip of a publication besides JP,9-324425,A will also be thrust by rotation all over the foundation, and will go and earth and sand are sent up from between hemicycle plates, penetrating will be checked when a big stone, earth and sand, grit, etc. are got blocked in the clearance.

**[0007]** Moreover, in the pile lower limit section, although the foundation is deleted according to the digging cutting-edge effectiveness of a hemicycle plate depended alternately and it goes, a penetrating rate may fall extremely on firm ground. Although there is an advantage of being easy to intrude since a tip is an open end, with a rotation laying-under-the-ground pile given in JP,11-269875,A, when especially a pile diameter is large, if ground is not so firm, it will be hard to acquire sufficient bearing capacity. Moreover, since the span is fixed from the aerofoil start edge, there is also a problem of being easy to damage an aerofoil.

[0008] The invention in this application aims at offering the pile with an aerofoil which solution of the above technical problems in the conventional technique is aimed at, and it excels in the intrusiveness to hard supporters, and is hard to damage an aerofoil, and can also take large end bearing capacity of a pile.

[0009]

[Means for Solving the Problem] The pile with an aerofoil concerning claim 1 of this application is characterized by having the part which comes to prepare an aerofoil in the upper pile periphery of said cone-like section spirally, and the span of said aerofoil increases gradually from the start edge, and preparing about one or more parts with an almost fixed span continuously while it prepares the cone-like section which has a digging cutting edge in the point of a pile.

[0010] Although the steel pipe pile is mainly considered about the body of a pile, it is not necessary to limit to a steel pipe pile, and a steel concrete compound pile or a concrete pile is sufficient. Although the digging cutting edge of the letter of a projection was just attached [ the digging cutting edge ] in two or more independence in forms, such as \*\* and a digging bit, at the cone-like section, what twisted reinforcement around the others and cone-like section spirally may be used. Moreover, digging nature can be raised if a deformed bar is used in the case of reinforcement.

[0011] By forming a digging cutting edge in the cone-like section of a pile point, since digging nature can improve, penetrating to hard supporters can become easy and supporters can be made to do penetrating of the pile point besides the cost reduction effectiveness by improvement in workability certainly, high end bearing capacity of a pile can be expected, and a reliable pile is obtained.

[0012] The height of the cone-like section has desirable less than 2.5-time extent of the path of the body of a pile. There is a possibility that the reinforcement of this part may run short in case of the height of 2.5 times or more, it may be easy to become unstable, and penetrating plumbness may also worsen. About the aerofoil spirally prepared in a pile periphery, since a span is the configuration increased gradually from the start edge, resistance by the aerofoil leader at the time of rotation becomes small, and breakage of an aerofoil and damage can be prevented. That is, rotation penetrating of a pile is carried out smoothly and it becomes easy to eat also into a hard layer by preparing this gradual increase part. When smooth penetrating is considered as die length of this gradual increase part, the thing which is a body periphery of a pile and which it winds 0.25 and is been a grade above is desirable.

[0013] Furthermore, since the span has prepared about one or more almost fixed parts about the vertical bearing capacity in an aerofoil part, the uniform stable bearing capacity is expectable in a pile hoop direction. In addition, when preparing about 0.25 parts which the span of an aerofoil leader increases gradually is considered, the total number of turns of an aerofoil part becomes 1.25 or more rolls.

[0014] however, since possibility of becoming the trouble of rotation penetrating can be considered when a stone etc. is got blocked in the clearance between aerofoils if the number of turns in the part of about 1 law has too many spans, in order to prevent this, it is desirable for a span to hold down the part of about 1 law to about one volume. When the effectiveness which pushes up earth and sand upwards at the time of rotation penetrating of a pile, the effectiveness of the improvement in bearing capacity by expansion of a back-face product, and the rigidity of the plate (usually steel plate) which constitutes an aerofoil are considered about a span, it is desirable to make a span into about 1.5 to 3 times of the path of the body of a pile.

[0015] In the case of 1.5 or less times, neither the effectiveness which pushes up earth and sand upwards, nor the effectiveness of the improvement in vertical bearing capacity is necessarily enough, by 3 or more times, an aerofoil can be damaged by resistance at the time of rotation penetrating, or possibility of becoming easy to be damaged can be considered. However, preparing a reinforcing rib in the front face or the periphery section of an aerofoil, changing the quality of the material of the aerofoil itself, or increasing thickness, and enlarging a span further is also considered so that it may mention later.

[0016] Claim 2 limits the case where it has the part which a span dwindles further following a part with the almost fixed span of said aerofoil, in the pile with an aerofoil concerning claim 1. By

forming a gradual decrease part in the upper part of an aerofoil other than the gradual increase part located in the lower part of an aerofoil, when using a pile as a temporary pile, drawing withdrawal becomes smooth. Moreover, during rotation penetrating, even when it is not a temporary pile, when the reverse sense wants to rotate a pile by a certain reason, inverse rotation becomes smooth and damage on an aerofoil etc. can be prevented.

[0017] Claim 3 limits the case where the reinforcing rib is prepared in the front face of said aerofoil, in a pile with an aerofoil according to claim 1 or 2. Although it is in the key objective which prepares a reinforcing rib raising the rigidity of an aerofoil part, and enabling it to take a larger span, it is also possible to raise the frictional resistance lateral friction side friction skin friction between the body of a pile and the foundation depending on the configuration of a reinforcing rib, or to reduce resistance of rotation penetrating.

[0018] For example, the drag force to the force in which it bends an aerofoil in the vertical direction when a reinforcing rib is prepared in radial [ of an aerofoil ] improves, and when a reinforcing rib is made to incline and is attached, the earth and sand of the aerofoil upper and lower sides are called in in the direction of the front face of a pile body, and improvement in frictional resistance lateral friction side friction skin friction can be aimed at. Moreover, this reinforcing rib can consider the case where it prepares in both vertical side, when preparing in the inferior-surface-of-tongue side of an aerofoil and preparing in a top-face side.

[0019] Claim 4 limits the case where said reinforcing rib is prepared in the outermost periphery of said aerofoil, in the pile with an aerofoil concerning claim 3. When a reinforcing rib is prepared in the outermost periphery of an aerofoil in the shape of a flange, earth and sand stop being able to escape outside a reinforcing rib easily at the time of rotation penetrating, and high frictional resistance lateral friction side friction skin friction can be expected between the body of a pile after construction, and the foundation. Moreover, it becomes possible to extend a span to about 5 times of the path of the body of a pile according to the improvement effectiveness in aerofoil rigidity as a reinforcing rib compared with the case where there is no reinforcing rib. That is, about 5 times can attain stabilization of the aerofoil at the time of construction, and can expect high pile bearing capacity according to it.

[0020]

[Embodiment of the Invention] Drawing 1 is what showed 1 operation gestalt of invention concerning claim 1 of this application, and has fixed the steel cone-like section 2 of a cone configuration by welding etc. at the tip of the body 1 of a pile which consists of a steel pipe. A deformed bar is spirally twisted around the cone-like section 2, and is welded to it, and it is considering as the digging cutting edge 3.

[0021] Moreover, the steel aerofoil 5 is spirally twisted around the body of pile 1 lower-limit section of the cone-like section 2 which hits up immediately, and it is welded to the front face of the body 1 of a pile. an aerofoil 5 has the small resistance which the span following gradual increase partial 5a and gradual increase partial 5a which the span from the leader a which hits the lowest edge of an aerofoil 5 increases gradually consists of span aliquot 5b of about 1 law, therefore Leader a and gradual increase partial 5a receive from the foundation, and rotation penetrating of a pile becomes smooth.

[0022] Drawing 2 is what showed the modification of the cone-like section 2 of a pile point, and is the case where the digging cutting edge 3 of the shape of two or more digging bit attached as a projection which became independent instead of the digging cutting edge 3 which consists of a deformed bar in drawing 1 is formed. The digging cutting edge 4 of drawing 2 searches for [ rather than ] the high cutting effectiveness from the hard layer in the foundation from the digging cutting edge 3 of drawing 1 planning comparatively smooth penetrating in rotation penetrating.

[0023] Moreover, to the digging cutting edge 3 by reinforcement volume attachment being formed simply cheaply, if it is the format of an independent projection of drawing 2, projection height and the number can be adjusted by the foundation and it can be coped with flexibly. In addition, in this example, eccentricity of the tip of the cone-like section 2 which formed the digging cutting edge 4 is carried out. The cone-like section may be manufactured using steel plates with irregularity, such as a checkered plate and a \*\*\*\*\* steel plate, and a height acts

as a digging cutting edge in that case.

[0024] Drawing 3 is what showed 1 operation gestalt of invention concerning claim 2 of this application, and gradual decrease partial 5c which a span dwindles towards Trailer b about an aerofoil 4 following gradual increase partial 5a from Leader a and middle span aliquot 5b further is formed. When it is necessary to remove later as effectiveness of gradual decrease partial 5c, using a pile as a temporary pile, the drawing withdrawal becomes smooth. Moreover, it is advantageous when a pile needs to be returned during rotation penetrating.

[0025] For gradual increase partial 5a, about 0.25 rolls and span aliquot 5b are [ about one roll and gradual decrease partial 5c ] about 0.25 rolls, and the number of turns of the aerofoil 5 in this case has become about 1.5 rolls as a whole. Moreover, if the location of the trailer of \*\*\*\*\* 3 and the leader a of an aerofoil is doubled as shown in drawing, the contamination of a between [ the aerofoils 5 of earth and sand ] becomes smooth, and large pile frictional resistance lateral friction side friction skin friction can be taken as a result.

[0026] Drawing 4 is what showed the pile point in 1 operation gestalt of invention concerning claims 3 and 4, stiffens an aerofoil 5 and enables it to control deformation of the aerofoil 5 at the time of rotation penetrating by forming the downward reinforcing rib 6 in an aerofoil 5. Moreover, especially this example is the case where a reinforcing rib 6 is formed in the periphery section of an aerofoil 5, stops easily being able to escape outside the reinforcing rib 6 with which earth and sand were attached in the shape of a flange, and can take the large frictional resistance lateral friction side friction skin friction between the body 1 of a pile, and the foundation so that it may be specified to claim 4.

[0027] Drawing 5 is what showed the pile point in other operation gestalten of invention concerning claims 3 and 4, and is making the reinforcing rib 6 project up and down in the example of drawing 5 to having formed the reinforcing rib 6 downward in drawing 4. Drawing 6 is what showed the pile point in other operation gestalten of invention concerning claims 1 and 2 of this application, it establishes two or more cement milk deliveries 7 in the point and the cone-like section 2 of the body 1 of a pile, raises the reinforcement of a pile point by impregnation of solidification material, such as cement milk, and is aiming at the stability and increase of end bearing capacity of a pile.

[0028] In addition, when using the pile with an aerofoil of the invention in this application as a bored precast pile bore hole, bearing capacity can be stably taken by carrying out stirring mixing of the solidification material with discharge and the excavated soil sand of the pile circumference from the cement milk delivery 7 at the time of rotation penetrating of a pile, and hardening the foundation of the pile periphery section.

[0029]

[Effect of the Invention] \*\* When carrying out penetrating of the pile tip from a soft layer to a hard layer to carrying out penetrating attainment to a stratum comparatively hard in order for the biggest technical problem of the pile of a rotation penetrating type to expect pile bearing capacity, Or when there is a comparatively hard layer in the middle of pile penetrating, eat away with the conventional pile and capacity is insufficient. As opposed to having been a pile tip's becoming close to a "skid" condition in the same depth location, and construction time amount's becoming remarkably long, and producing a problem with the pile of the invention in this application Compared with the conventional pile of the same kind, penetrating becomes it is remarkable and easy by having the cone-like section equipped with the digging cutting edge at the tip of a pile as mentioned above, and having prepared the gradual increase section in the leader of an aerofoil.

[0030] \*\* Also in construction expense, the large reduction effectiveness is expectable again by having carried out possible [ of carrying out smoothly of penetrating of a pile, and the certain and quick setting depth to supporters ].

\*\* In invention concerning claim 2, since the gradual decrease part is prepared also above the aerofoil, when using as a temporary pile, drawing withdrawal becomes smooth.

[0031] \*\* In invention concerning claim 3, the bearing capacity which the resistance to the external force of an aerofoil became large, and rotation penetrating of a pile became more smooth, and was stabilized by having prepared the reinforcing rib in the aerofoil is acquired.

Furthermore, expansion of a wing diameter is also possible.

\*\* In invention concerning claim 4, the restricted effectiveness of the earth and sand by the reinforcing rib of the shape of a flange prepared in the aerofoil periphery section is acquired, and the large frictional resistance lateral friction side friction skin friction between a pile and the foundation can be taken.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

**[Drawing 1]** It is what showed 1 operation gestalt of invention concerning claim 1 of this application, and is (a). The front view of a pile point with an aerofoil, and (b) It is a bottom view.

**[Drawing 2]** It is the front view showing the modification of the cone-like section of a pile point.

**[Drawing 3]** It is what showed 1 operation gestalt of invention concerning claim 2 of this application, and is (a). The front view of a pile point with an aerofoil, and (b) It is a bottom view.

**[Drawing 4]** It is the front view of the pile point in 1 operation gestalt of invention concerning claims 3 and 4 of this application.

**[Drawing 5]** It is the front view of the pile point in other operation gestalten of invention concerning claims 3 and 4 of this application.

**[Drawing 6]** It is the front view of the pile point in other operation gestalten of invention concerning claims 1 and 2 of this application.

**[Description of Notations]**

a [ — The cone-like section, 3 / — A digging cutting edge, 4 / — A digging cutting edge, 5 / — An aerofoil, 5a / — The span aliquot, 5b / — A gradual increase part, 5c / — A gradual decrease part, 6 / — A flange-like reinforcing rib, 7 / — Cement milk delivery ] — The aerofoil start edge, b — Aerofoil termination, 1 — The body of a pile, 2

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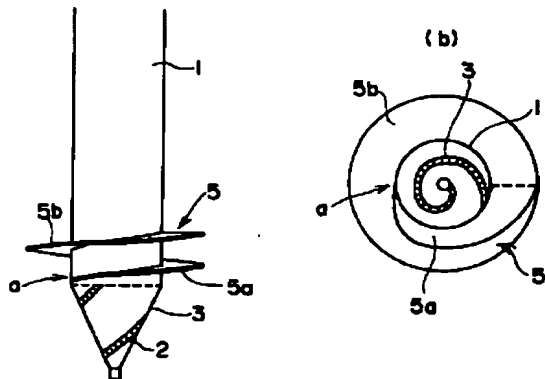
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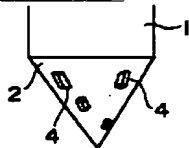
**DRAWINGS**

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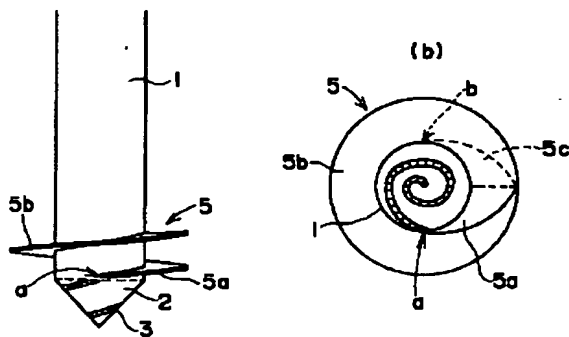
[Drawing 1]  
(a)



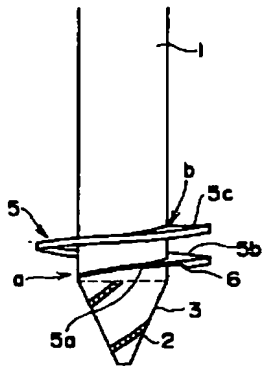
[Drawing 2]



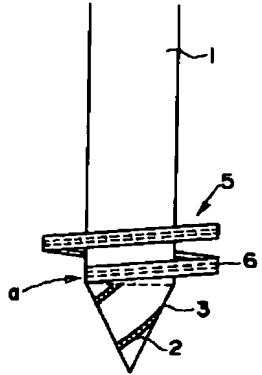
[Drawing 3]  
(a)



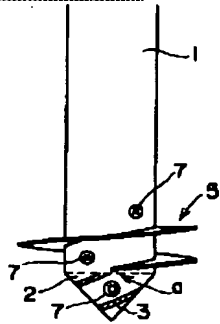
[Drawing 4]



[Drawing 5]



[Drawing 6]



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